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## ORIGINAL ARTICLE

# Physical Activity Patterns and Quality of Life of Overweight Boys: A Preliminary Study

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physical activity;  
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**Summary** *Objective:* We compared the physical activity (PA) patterns and the quality of life (QoL) between overweight and normal-weight boys, and examined the relationship between PA and QoL of overweight boys.

*Methods:* Eighteen overweight boys (age range: 8–10 years, mean  $\pm$  standard deviation:  $9.36 \pm 0.82$  years) and 18 age-matched, normal-weight counterparts (age range: 8–10 years, mean  $\pm$  standard deviation:  $9.01 \pm 0.65$  years) participated in this study. All participants were in the 3<sup>rd</sup> or 4<sup>th</sup> grade. Each boy completed a QoL questionnaire and wore an accelerometer on his waist for a week to measure his PA during that period. Independent *t* tests were used to examine the differences in QoL and PA between the overweight and normal-weight boys. Paired *t* tests were used to test the differences in PA between weekdays and weekend days for each group. Finally, Pearson correlations were used to analyze the relationships between PA and QoL in overweight boys.

*Results:* Overweight boys reported a significantly lower QoL, and participated in significantly less PA on weekends than did normal-weight boys. A moderate and marginally significant correlation was found between PA on weekends and QoL in overweight boys.

*Conclusion:* Our findings suggest the importance of increasing weekend PA for overweight boys. Occupational therapists should encourage overweight boys to engage in PA that the boys are interested in on weekends, and conduct a PA program for overweight boys.

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## Introduction

Overweight is an important health problem for children in many countries around the world (Sweeting, 2008). The high prevalence of overweight in children (one-third of children 6–19 years old in the United States [Ogden, Carroll, Curtin, Lamb, & Flegal, 2010], and nearly one-third of boys and one-fourth of girls in Taiwan [Chu & Pan, 2007]) has made overweight a major public health concern. Overweight children are likely to develop physical diseases, such as cardiovascular disease and type 2 diabetes, and encounter psychosocial issues, such as being teased and having low self-esteem, due to their weight (Puhl & Latner, 2007; Sweeting, 2008). Because occupational therapy is aimed at preventing future illness and improving the health and quality of life (QoL) of clients (American Occupational Therapy Association, 2007), the American Occupational Therapy Association has publicly addressed concerns about obesity and its prevention (Blanchard, 2006).

Occupational therapy plays an important role in weight management and related health concerns by helping clients engage in emotionally satisfying daily activities (Clark, Reingold, & Salles-Jordan, 2007). To provide interventions tailored to clients' habits and preferences, it is necessary to analyze performance patterns related to daily life activities (Wilcock, 1998; Yerxa, 2002). Analyzing these activities in terms of energy expenditure, physical exertion, and physical activity (PA) is informative given the existing literature on the relationship between PA patterns and overweight.

The frequency, intensity, and duration of PA can be assessed by using subjective measures (e.g., self-reports) (Lazzer et al., 2003) and objective instruments (e.g., an accelerometer) (Hughes, Henderson, Ortiz-Rodriguez, Artinou, & Reilly, 2006; Treuth et al., 2007). The accelerometer has garnered growing attention because it can show PA patterns over a period of time to provide information on how intensely the participants were physically involved in whatever they were doing. Therefore, it can quantify PA over a combination of days (e.g., weekdays vs. weekends) without the bias of social desirability or the tendency to over-report PA (Treuth et al., 2007). In addition, accelerometers allow a detailed portrait of PA patterns by providing the minute-by-minute intensity of daily PA (Nader, Bradley, Houts, McRitchie, & O'Brien, 2008). For example, as an individual plays a 1-hour baseball game, an accelerometer records how many minutes of PA are light, moderate, or vigorous rather than counting that 1 hour as 60 minutes at the same intensity. By using these measures, research has indicated that overweight children engage in a lower level of PA and less daily moderate-to-vigorous PA (MVPA) than do normal-weight children (Deforche, De Bourdeaudhuij, D'hondt, & Cardon, 2009; Treuth, Hou, Young, & Maynard, 2005; Treuth et al., 2007). MVPA was specifically estimated because for PA to benefit health, it should be moderate or vigorous, and children need at least 60 minutes of MVPA per day (U.S. Department of Health and Human Services, 2008).

Because attending school is the major occupation of children 6 years old and older, their daily life activities are constrained by their school schedules. Therefore, children have different activities and PA patterns on weekdays and weekends (Saw, Nieto, Katz, & Chew, 1999). Only a few

studies (Deforche et al., 2009; Treuth et al., 2005, 2007) in Western countries have examined the PA patterns of overweight children across weekdays and weekends. To the best of our knowledge, however, no published studies have examined PA patterns across weekdays and weekends in Asian countries, which may have activity patterns different from those in Western countries. For example, Taiwanese children spend less time on TV but more time on their homework compared with European-American and Mexican-American children (Chen & Kennedy, 2005). In addition, most children in Taiwan, Japan, and China go to cram school for a few hours after spending all day in public or private school (Lijima, Kondo, Koyama, & Higurashi, 1999; Lin & Huang, 2009; Liu, 2008).

Occupational therapy provides interventions for the management of overweight with the goal of improving clients' QoL. QoL is a multidimensional construct defined as physical health, psychological state, personal belief, and social relationships; it reflects one's self-perception of expectations and concerns in the context of the culture and its value systems (World Health Organization, 1993), and is useful for school contexts. It was found that a child's weight (Hughes, Farewell, Harris, & Reilly, 2007; Williams, Wake, Hesketh, Maher, & Waters, 2005) and PA (Chen et al., 2005) are related to QoL. Overweight children report significantly lower QoL (Hughes et al., 2007; Williams et al., 2005) and have lower levels of daily PA (Patrick et al., 2004; Treuth et al., 2007; Trost, Kerr, Ward, & Pate, 2001) than do normal-weight children. In addition, overweight children with higher PA levels rated their QoL as higher than those with lower PA levels (Shoup, Gattshall, Dandamudi, & Estabrooks, 2008). However, there is only limited published information on the relationship between QoL and PA on weekdays and weekends in overweight children. Therefore, the purposes of this study were to compare PA between overweight boys and normal-weight boys on a random week in the middle of the semester, and to estimate the relationship between weekday and weekend PA and QoL in overweight boys. Our findings may provide occupational therapists with information for intervention plans to improve QoL for overweight children.

## Methods

### Participants

We recruited healthy 8- to 10-year-old 3<sup>rd</sup>- and 4<sup>th</sup>-grade boys, a fairly homogeneous sample, for this study. Based on the recording of the body mass index (BMI) of the students in one elementary school in southern Taiwan, we invited 50 of their overweight and 50 of their normal-weight boys to participate in this study. All study participants and their parents provided appropriate written informed consent. The Institutional Review Board of National Cheng Kung University approved this study.

### Instruments

#### Body mass index and body fat

Height was measured using a stadiometer, and weight and body fat were measured using a body fat monitor (UM014;

Tanita Health Equipment H.K. Limited, Kowloon, Hong Kong). BMI was calculated by weight in kilograms divided by the height in meters squared ( $\text{kg}/\text{m}^2$ ). Cole, Bellizzi, Flegal, and Dietz (2000) and Sweeting (2008) suggest that the cutoff for overweight in a country should be based on its national population. Therefore, according to a national study in Taiwan (Chu & Pan, 2007), 8- to 9-year-old boys with a BMI above 19.3, and 9- to 10-year old boys with a BMI above 19.7 are considered overweight.

### Physical activity

We used an accelerometer (ActiGraph GT1M; ActiGraph, LLC, Pensacola, FL, USA) that has been reported (Corder et al., 2007) to be highly correlated with the Computer Science & Applications (CSA) Model 7164 ( $r = 0.95$ ), an earlier model that was shown (Puyau, Adolph, Vohra, & Butte, 2002; Trost et al., 1998) to have adequate validity and inter-rater reliability. The accelerometer must be worn for at least 3 weekdays and 1 weekend day to yield valid data (Trost, Pate, Freedson, Sallis, & Taylor, 2000). The PA metabolic equivalents (METs) for children between 6 and 18 years old were derived using the Freedson equation (Freedson, Pober, & Janz, 2005):  $\text{METs} = 2.757 + (0.0015 \times \text{counts}/\text{min}) - (0.08957 \times \text{age in years}) - (0.000038 \times \text{counts}/\text{min} \times \text{age in years})$ , where counts/min were recorded using the accelerometer. PA must be  $\geq 3$  METs to be considered as MVPA (Trost et al., 2001). Because of the different daily activities (Nader et al., 2008; Saw et al., 1999) between weekdays and weekends for school children, we used the following equation to represent minutes of MVPA in one week:  $(\text{mean minutes of MVPA per weekday} \times 5) + (\text{mean minutes of MVPA per weekend day} \times 2)$ .

### Quality of life

The Pediatric Quality of Life Inventory 4.0 (PedsQL) is a modular instrument for measuring health-related QoL. This 23-item questionnaire asks the frequency of a problem's occurrence during the previous month; the frequency is then transformed into a 0 to 100 scale according to the developer's instructions (Varni, Burwinkle, Seid, & Skarr, 2003). Higher scores indicate a better QoL. Detailed information for the development, psychometric properties, and use of the PedsQL has been reported elsewhere (Lin et al., 2012; Varni et al., 2003).

### Procedures

Participants were randomly divided into eight groups ( $n = 5-7$  each), with each group having similar numbers of overweight and normal-weight boys. Each group was measured at different time points. One researcher measured the height, weight, and body fat, and calculated the BMI of the boys in each group at the beginning. The boys then filled out the PedsQL questionnaire in a classroom under the researcher's supervision. All participants were asked to continuously wear the accelerometer on the right anterior pelvis from the time they awakened for 7 consecutive days—5 weekdays and 2 weekend days—unless participating in water activities such as bathing and swimming. Seven accelerometers were used in this study. A

written version of these instructions was also given to the parents and teachers of the participants. After 7 days, the accelerometer was retrieved for data analysis.

### Statistical analysis

The differences in demographics, QoL scores, and PA (on weekdays, weekend days, and during the 1-week PA accelerometer assessment) between the overweight and normal-weight boys were analyzed using two-tailed independent  $t$  tests. PA on weekdays and PA on weekend days were compared using two-tailed paired  $t$  tests for the overweight and normal-weight groups.

The correlations between PA and QoL scores were analyzed using Pearson correlation coefficients adjusted by age for the overweight group. Significance was set at  $p < .05$ . All data were normally distributed, and all were analyzed using SPSS 16.0 (SPSS Inc., Chicago, IL, USA).

## Results

### Participant characteristics

A total of 49 boys (25 overweight and 24 normal-weight) agreed to participate in the study. All participants understood and completed the PedsQL questionnaires by themselves. Only 36 boys (18 overweight and 18 normal-weight) wore an accelerometer for at least 3 weekdays and 1 weekend day; the other 13 boys did not wear it long enough to permit analysis. The overweight boys were significantly heavier and had higher BMIs and higher body fat percentages than did the normal-weight boys (Table 1).

### Comparisons of PA and QoL between the two groups

Overweight boys had lower QoL scores compared with normal-weight boys. Sixteen overweight boys (88.9%) and all normal-weight boys met the U.S. Department of Health and Human Services-recommended guidelines of more than 60 minutes of MVPA daily. However, the overweight boys had significantly fewer minutes of MVPA than did the normal-weight boys in a week, per weekend day, and after school on weekdays (Table 2). In addition, the overweight

**Table 1** Participant Characteristics.

	Overweight boys ( $n = 18$ )		Normal-weight boys ( $n = 18$ )		$p$
	Mean	SD	Mean	SD	
Age (y)	9.36	0.82	9.01	0.65	.253
Height (cm)	138.23	7.31	134.06	7.32	.096
Weight (kg)	47.80	8.47	31.51	5.02	<.001
BMI ( $\text{kg}/\text{m}^2$ )	24.80	2.86	17.33	1.35	<.001
Body fat (%)	32.48	7.27	19.09	4.54	<.001

BMI = body mass index; QoL = quality of life; SD = standard deviation.

**Table 2** Comparison of Quality of Life (QoL) and Moderate-to-Vigorous Physical Activity (MVPA) between the Two Groups.

	Overweight boys ( <i>n</i> = 18)		Normal-weight boys ( <i>n</i> = 18)		<i>p</i>
	Mean	SD	Mean	SD	
QoL score	81.04	10.85	89.67	8.40	.012
Whole week <sup>a</sup> (min)	735.15	270.32	938.71	214.65	.02
Weekday <sup>a</sup> (min)	113.19	38.46	136.70	33.56	.059
At school <sup>b</sup> (min)	66.09	19.87	72.85	20.46	.322
After school <sup>b</sup> (min)	41.23	27.14	58.05	21.69	.048
Weekend <sup>a</sup> (min)	84.61	54.67	127.60	70.01	.048
<i>p</i> <sup>c</sup>	.016		.630		

SD = standard deviation.

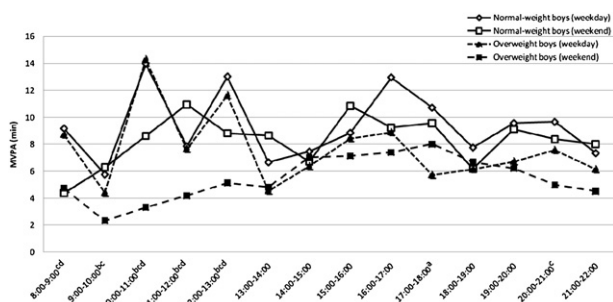
<sup>a</sup> Whole week = total minutes of MVPA in a week; weekday = mean minutes of MVPA per day on weekdays (24 hours); weekend = mean minutes of MVPA per day on weekend days (24 hours).

<sup>b</sup> At school = 8:00 to 16:00; after school = 16:00 to 22:00.

<sup>c</sup> Comparison between weekday and weekend MVPA.

boys participated in significantly less PA on weekends than on weekdays, whereas the normal-weight boys participated in approximately the same amount of PA on weekends and weekdays.

The trends of PA appeared to be similar between overweight and normal-weight boys on weekdays, especially during the school period (08:00–16:00) (Fig. 1). Both overweight and normal-weight boys had bursts of activity in the morning (10:00–11:00), at noon (12:00–13:00), and in the early afternoon (15:00–16:00) on weekdays. These three bursts contributed 31.2% of total MVPA in the overweight group (13.4% between 10:00 and 11:00; 10.6% between 12:00 and 13:00; 7.2% between 15:00 and 16:00) and 27% in the normal-weight group (10.6%, 9.8%, and 6.6%, respectively). In contrast, the weekend PA pattern was significantly ( $p < .05$ ) different between the two groups: the overweight boys had less MVPA compared with the normal-weight boys, especially in the morning.



**Figure 1** Weekday and weekend comparison of the minutes of MVPA from 8:00 to 22:00 in both groups. MVPA = moderate-to-vigorous physical activity. <sup>a</sup>  $p < .05$  between the two groups on weekdays; <sup>b</sup>  $p < .05$  between the two groups on weekends; <sup>c</sup>  $p < .05$  between weekdays and weekends in the overweight group; <sup>d</sup>  $p < .05$  between weekdays and weekends in the normal-weight group.

## Correlations between PA and QoL in the overweight group

Partial correlation was used because moderate correlations between age and PA ( $r = -.54$  on weekdays and  $-.42$  on weekends) and between age and QoL ( $r = .31$ ) were found in our data. After controlling for age, the correlation for the overweight group between weekend MVPA and QoL total score was moderate ( $r = .47$ ) and marginally significant, ( $p = .06$ ), but did not reach the significant level. Overweight boys with higher PA levels on weekends had higher QoL scores. However, the correlation between weekday MVPA and QoL total score ( $r = .11$ ,  $p = .62$ ) was low and nonsignificant for the overweight group.

## Discussion

This study compared PA patterns between overweight and normal-weight boys on weekdays and weekends, and investigated the relationship between PA and QoL for overweight boys. We found that overweight boys had lower PA levels than normal-weight boys after school on weekdays, on weekends, and for an entire week. In addition, overweight boys had lower PA levels on weekends than on weekdays. Moreover, the results indicated that overweight boys had a lower QoL than their normal-weight counterparts, and that overweight boys with more minutes of MVPA on weekends had a higher QoL.

Overall, our findings are in agreement with previous findings that overweight boys had lower PA levels than did normal-weight boys (Hughes et al., 2006; Lazzer et al., 2003), and that the difference in PA levels occurred mainly on weekends, not weekdays at school (Deforche et al., 2009; Treuth et al., 2007). Our findings suggest that the PA of both overweight and normal-weight boys was constrained by school activities, as evidenced by three bursts of MVPA on weekdays. The 10:00 to 11:00 PA included a required physical education period from 10:00 to 10:15 every weekday. The 12:00–13:00 burst was lunchtime, and most students played on the playground after having lunch. The 15:00–16:00 burst occurred because all the students were asked to clean up the campus from 15:00 to 15:20. The 10-minute breaks between classes were apparently not long enough for students to engage in PA other than walking to the restrooms or drink machines; they did not have to change classrooms.

The overweight boys in our study seemed to have more MVPA (105 minutes per day) than did the overweight children in previous studies (20–70 minutes per day) (Deforche et al., 2009; Ekelund et al., 2002; Hughes et al., 2006; Patrick et al., 2004; Shoup et al., 2008; Treuth et al., 2007; Trost et al., 2001) that used accelerometers (CSA 7164 or ActiGraph GT1M) to measure PA. One reason for the difference is probably related to the arbitrary cutoffs used to define the intensity of PA, such as MVPA defined as  $\geq 2000$ ,  $\geq 3000$ , or  $\geq 3200$  counts/min (Deforche et al., 2009; Hughes et al., 2006; Treuth et al., 2007). However, the Freedson equation (Freedson et al., 2005) used in this study should be appropriate because it adjusts METs by age and has been used in many population studies (Nader et al., 2008; Riddoch et al., 2004). Another reason for the



difference may be attributable to the younger age of the participants in our study (mean age: 9.4 years in the present study vs. 12.7, 11.4, and 10.6 years in previous studies [Patrick et al., 2004; Shoup et al., 2008; Trost et al., 2001]), because PA is reported to decrease with age (Nader et al., 2008; Riddoch et al., 2004). Finally, the physical education policy in the school that required all children to exercise from 10:00 to 10:15 may also have contributed to the higher PA levels in this study.

In contrast to the similar PA patterns of both groups at school, the overweight boys in our study spent less time than did normal-weight boys engaging in MVPA after school and on weekends. In addition, our results indicated that PA was lower on weekends than on weekdays for the overweight but not the normal-weight boys. The reason could be that overweight children tended to engage in more sedentary activities after school and on weekends, such as playing computer games and watching TV, than did normal-weight children (Deforche et al., 2009). Unlike PA, however, computer games and watching TV are not beneficial for children's health (U.S. Department of Health and Human Services, 2008).

The benefits of PA for overweight boys may be inferred from our findings that the QoL of overweight boys was moderately and positively correlated with their PA on weekends. These findings are consistent with previous findings that participating in regular PA was positively related to QoL in children (Chen et al., 2005), and that overweight children who met PA recommendations had a higher QoL than those who did not (Shoup et al., 2008). Overall, these results suggest that PA is a positive contributor to QoL in overweight children. Examining the relationship between PA on weekdays and weekends separately, we extended previous findings (Chen et al., 2005; Shoup et al., 2008) by showing an association between weekend PA and QoL for overweight boys, which highlights the importance of weekend PA for overweight boys.

The reason for a correlation between PA on weekends and QoL in overweight boys might be that the boys could choose their preferred PA on weekends, in contrast to the scheduled, required PA at school. It is interesting to notice that, although the school physical education policy seems to increase MVPA, it appears not to contribute to a higher QoL for overweight boys. This may be because the physical education activities were not interesting to them or did not provide them any positive feelings of achievement. For example, they may get negative comments when participating in PA (Puhl & Latner, 2007). Further investigations are needed to identify factors moderating the relationship between PA and QoL, such as motivation and social support.

## Clinical implications

Our findings emphasize the importance of weekend PA for overweight boys. Occupational therapists may use, for example, the Person–Task–Environment (PTE) model (Holm, Rogers, & Stone, 2008) to guide intervention programs. The PTE model focuses on the discrepancy between the client's current and desired performance and suggests that occupational therapists design interventions

to resolve the discrepancy by considering three domains: person, task, and environment. Interesting PA programs based on the preferences and abilities of overweight children should be designed, the weekend schedule of the children's family should be considered, as should the different energy levels of students based on their weight (e.g., overweight, obese, and extremely obese) to better suit their needs. Parents may be encouraged to schedule outdoor activities with their overweight children or to let their children participate in some sports clubs. The coaches in these clubs may also be educated on how to design and grade sports or exercise based on children's preferences and abilities (Mosley, Jedlicka, Lequieu, & Taylor, 2008).

In addition, one reason for the nonsignificant correlation between QoL and weekday PA might be that overweight children did not like their PA at school. Therefore, schoolteachers need to consider the preferences and abilities of overweight children; the PTE model may also be applied at school. Occupational therapists can provide schoolteachers with information about physical education activities that children are interested in and that can be incorporated into educational curriculums to increase energy expenditure (Mosley et al., 2008). For instance, fun-based skill learning, such as competitive activities that provide a positive experience, may motivate overweight children to engage in PA. In addition, it is important to help develop playgrounds at school with different intensities of age-appropriate activities to promote participation in PA that is meaningful to the students. Peers, teachers, and parents need to be educated about how to interact with overweight children as well. Positive comments made to overweight children about their athletic abilities can give them positive feelings about PA and motivate them to enjoy it.

## Study limitations

A primary limitation of this study is the school policy of increasing students' PA. Because we were unable to manipulate this school policy, the effect of attending physical education classes was not clear to us, and the association between PA and QoL on weekdays in overweight boys may thus be confounded. In addition, due to the cross-sectional design of this study, we could not examine the causality or temporality of the association. Finally, we recruited only 8- to 10-year-old boys and our sample size was small, which makes it difficult to generalize our results to a wider population of children.

## Future research

Our findings suggest a number of paths for future research in the area of weight status, PA, and QoL. First, future studies can recruit a wider pediatric population, including both genders and a wider age range, to provide more information related to PA and QoL in overweight children. Second, because activities for children vary between holidays (e.g., weekends), vacations (e.g., summer or Chinese New Year), and school semesters (Saw et al., 1999), future studies may also examine PA patterns and the associations between PA and QoL in overweight children during these periods. The information would help occupational

therapists provide intervention tailored to the clients' circumstances. Third, future studies may use both accelerometers and activity daily logs to understand the pattern of time-use by children for a whole week. In addition, we assume that the weak association between PA at school and QoL is because overweight children are not interested in school-mandated PA. It is important for occupational therapists to design PA programs at school that are tailored to children's preferences and abilities and to examine the effectiveness of such programs on activity levels and QoL in overweight children. Finally, a larger-scale, more comprehensive investigation on childhood lifestyles (e.g., stress, dietary habits, and PA) and cooperation with people in different disciplines (e.g., dieticians) is important for improving our knowledge on childhood obesity and developing effective intervention programs.

## Conclusion

The present study provides evidence that overweight and normal-weight boys engage in different patterns of after-school and weekend PA. Although our sample size was not large enough for a cross-sectional study, our finding of a positive correlation between weekend PA and QoL in overweight boys suggests the importance of weekend PA for their QoL. When providing intervention programs for overweight boys, occupational therapists should take into consideration their preferences, circumstances, and contexts to design activities that are interesting to and feasible for them (Clark et al., 2007). In addition, occupational therapists should encourage overweight boys to find PA they enjoy and, when they are not in school, to participate in activities that they are interested in on weekends and after school on weekdays, such as clubs and sports.

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